The sense of body-ownership modulates cross-modal facilitation of tactile extinction in brain-damaged patients

Carlotta Fossataro
carlotta.fossataro@unito.it

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Pathological Embodiment

Can you reach your left hand with your right hand?

Embodiment evaluation

- Which object is in front of your left/right hand?
- Can you reach for your left hand?

“Embodying someone else’s hand means embodying both its **motor** and **sensory** properties”

De Vignemont, 2010
Sensory embodiment

Embodying someone else’s hand means embodying its sensory properties

Does the altered sense of body ownership may even affects multisensory integration process typically occurring close to one’s own body?

“I feel it”

Pia et al., Front Hum Neurosci (2013); Garbarini et al., Curr Biol (2014); Fossataro et al., Sci Rep (2016); Fossataro et al., Cortex (2017)
FAILURE TO IDENTIFY

tactile stimulus presented on the **contralesional side**

when a competing stimulus is presented on the **ipsilesional side**

**Cross-modal facilitation of Tactile extinction**

**TE Patients** fail to identify a tactile stimulus presented on the contralesional side when a competing stimulus is presented on the ipsilesional side.

**Visuo-tactile integration facilitates tactile detection of the contralesional stimuli**

- **Làdavas, Farnè and Zeloni. JoCN (1998)**
Visuo-tactile integration occurring within the peripersonal space (PPS) of the own hand is able to facilitate contralesional tactile detection.


Are visuo-tactile integration mechanisms modulated by body ownership?

Fossataro, Bruno, Bosso, Chiotti, Gindri, Farnè, Garbarini. (under review)
Materials & Methods

MAIN EXPERIMENT

4 E- Patients TE+

4 E+ Patients TE+

Naturalistic paradigm:
human-like robotic hands generated both tactile and visual stimuli

Fossataro, Bruno, Bosso, Chiotti, Gindri, Farnè, Garbarini. (under review)
Main Experiment

TE in both E+ and E- patients (failure to detect contralesional tactile stimuli)

Baseline

TE improvement only E+

No TE improvement in E-

TE improvement in both E+ and E-

No TE improvement in both E+ and E- patients

Ladavas et al., JoCN (1998)
Ladavas et al., Exp Brain Res (2000)

Fossataro, Bruno, Bosso, Chiotti, Gindri, Farnè, Garbarini. (under review)
Cross-modal visuo-tactile integration is conditional to body-ownership, so that it ameliorates tactile extinction when visual stimuli occur on what is believed to be one’s own body.
Materials & Methods

**MAIN EXPERIMENT**

4 E- Patients TE+

4 E+ Patients TE+

Naturalistic paradigm: human-like robotic hands generated both tactile and visual stimuli

**Experimental paradigm:** visual and tactile stimuli were dissociated (red LED did not predict the electrical stimuli)

** TE assessment**

which could be: the Fossataro, Bruno, Bosso, Chiotti, Gindri, Farnè, Garbarini. *(under review)*
Control Experiment

Both E+ and E- will show TE

Only E+ will show a TE amelioration

Both E+ and E- will show a TE amelioration

No TE amelioration in E-

Fossataro, Bruno, Bosso, Chiotti, Gindri, Farnè, Garbarini. (under review)
As in the main experiment, only in E+ patients, visual stimuli occurring on the examiner’s hand improved contralesional tactile detection.
Patients lesion mapping

Vallar et al., JNNP (1994)

Other involved brain regions are *Putamen, Insula* and *SLF*


Fossataro, Bruno, Bosso, Chiotti, Gindri, Farnè, Garbarini. *(under review)*
Conclusion

Visuo-tactile stimulation within the PPS surrounding the own hand was able to facilitate contralesional tactile detection in all TE+ patients, thus confirming the effectiveness of cross-modal integration paradigm as promising tool for rehabilitation.

Visuo-tactile integration is gated by body-ownership, so that it can occur only when visual stimuli appeared close to what is believed to be one’s own hand. The success of cross-modal rehabilitative training may benefit from a careful evaluation of the patients’ sense of body-ownership.

From a clinical point of view, both cross-modal paradigms employed here were effective at inducing a restoring of tactile extinction.

These data might represent an important premise to design ad hoc rehabilitation protocols that could be investigated in future clinical studies.

Fossataro, Bruno, Bosso, Chiotti, Gindri, Farnè, Garbarini. (under review)
Thank you for your attention!

https://manibuslab.wixsite.com/manibus

@ManibusLab
Neuropsychological assessment

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